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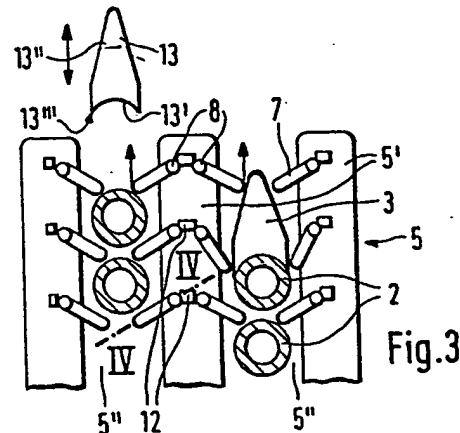
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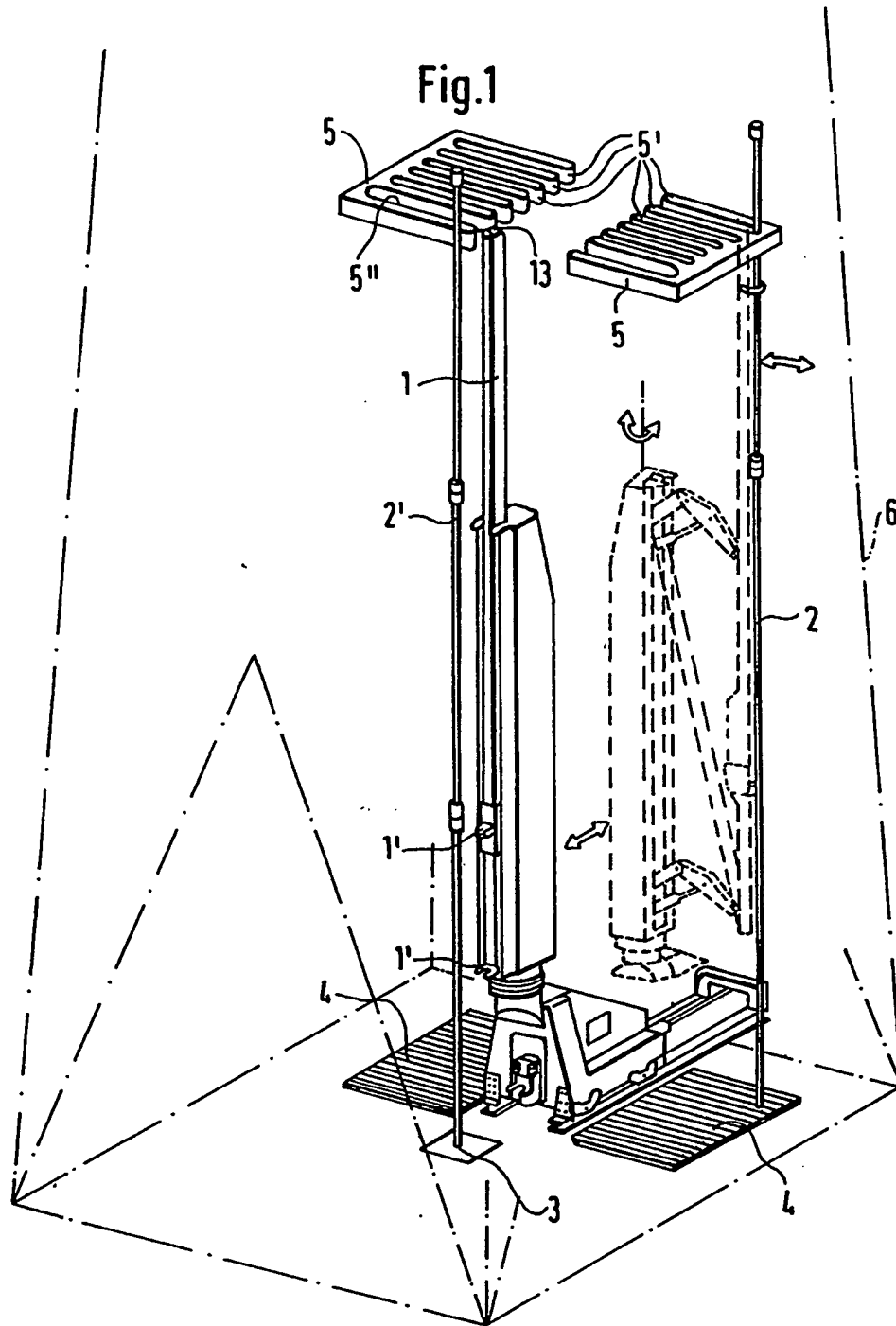
(54) A racking system for pipes

(57) A racking system for a drilling platform, which serves to move pipe string sections (2) between a position of use and a storage position, where the pipe sections are located in the vertical position in a rack or fingerboard with spaced horizontal parallel fingers. The fingers of the fingerboard (5) are equipped with spring-loaded, deflectable locking bolts (7) which work together in pairs to lock-in a pipe which has entered the gap between the two fingers. As a pipe enters, the pipe itself causes the locking bolts (7) to be deflected, and the pipe may pass one or more pairs of locking bolts to arrive at its storage position in the fingerboard.

For removal of a pipe, a specially shaped release head (13) on a pipe handling appliance is employed at the level of the fingerboard, which head is designed to be inserted into the gaps (5'') between the fingers (5') of the fingerboard, thus putting the locking bolts temporarily out of function while a pipe is removed from the fingerboard (5) by the release head.



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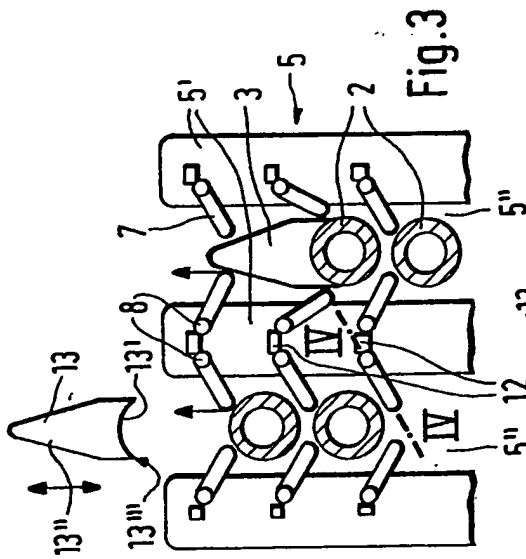


Fig. 3

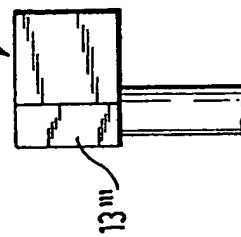


Fig. 2a



Fig. 2b

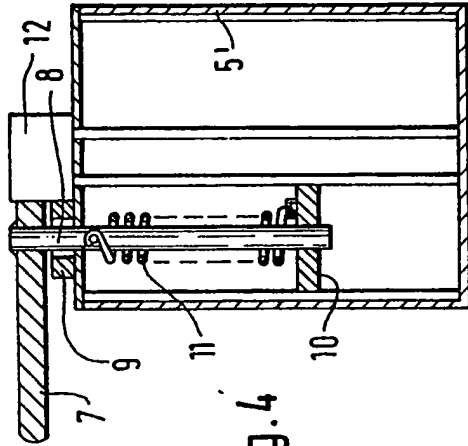


Fig. 4

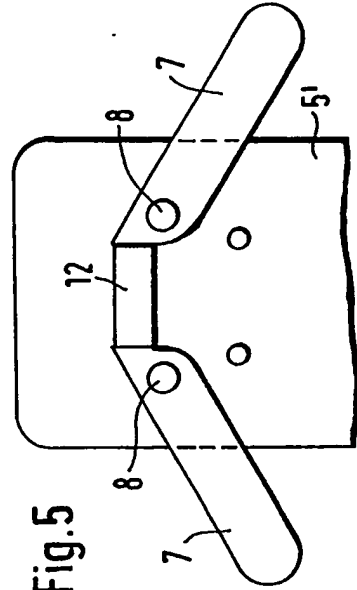


Fig. 5

SPECIFICATION

A racking system for pipes

5 The invention concerns a racking system for pipes and has a particularly useful but not exclusive application on drilling platforms.

During drilling of oil and gas wells the entire drill string must be tripped out and tripped in again
10 several times. During this process the drill pipe sections, which comprise about 30 metres of drill pipe, are stored by standing them vertically inside the drill derrick. The platform and drill derrick are equipped for this purpose with suitable racks

15 which serve to support the drill pipes during storage. The racks are sometimes called fingerboards. A fingerboard is provided with a number of parallel prongs or fingers with gaps between them the width of which somewhat exceeds the external diameter of the drill pipe. The gaps between the fingers are open at one end, through which the drill pipes can be moved in and out of the fingerboard.

A pipe handling appliance suitable for handling pipes under these conditions is described and
25 shown in Norwegian Patent Application No. 84 2425. This pipe handling appliance is designed to handle drill pipes in a largely vertical attitude between a position over the drill centre and a storage position in the fingerboard and vice versa. The appliance is fastened to a skid on the platform deck. Guidance arrangements provide for linear to and
30 from movement of the skid. A vertical shaft which carries the appliance structure is rotatably mounted on the skid. The appliance structure described in Norwegian Patent Application No. 84 2425 incorporates two long substantially vertical, structural parts, viz. a primary structural part which is rotatably connected to the skid, and a secondary structural part which is supported by and is parallel to but laterally displaced from the primary part.
40 By this means, the secondary part can be moved in and out in relation to the primary part while the two parts remain in a vertical attitude. The secondary part is equipped with gripping and holding devices which can be opened and closed for fixing a vertical drill pipe during handling operations.

In order that the stored, vertically stacked drill pipes should not fall out of the fingerboard, a lock arrangement must be provided which ensures that
50 the drill pipes are held in place in the fingerboard until needed. Known lock arrangements for this purpose consist of hydraulically or pneumatically operated mechanisms which are operated by remote control. In practice it is a question of looking
55 after approx 100 drill pipes, and known lock systems for fingerboard use have proven complicated and difficult to operate. Moreover, the procurement and maintenance costs of the large number of lock arrangements with associated remotely controlled
60 hydraulic or pneumatic operating mechanisms are very substantial.

According to this invention in one aspect there is provided a racking system for pipes, comprising a rack having horizontally-extending fingers with intervening gaps open at one end for the receipt and

removal of pipes in a vertical attitude, pairs of locking bolts the two bolts of each pair being pivotally mounted about respective vertical axes on adjacent fingers and spring-loaded into an end position in which each extends part-way across the gap between said adjacent fingers the arrangement being such that a pipe can be entered into the gap by forcing the two bolts apart against the action of the springs but that the pair then return to said end position and co-operate to prevent such pipe
70 from falling out of the gap, and a pipe handling appliance comprising means for gripping and holding a pipe in a vertical attitude, a release head movable into and out of the gap between adjacent fingers and shaped to force the fingers apart during such movement to provide access for the head to a pipe in the gap, said head having at its forward end a recess for accommodating a pipe in the recess for removal of the pipe with the release
85 head.

The invention also provides a racking system for storing pipes in an upright attitude comprising a rack having horizontally extending fingers with intervening gaps open at one end for receiving and removal of the pipes, and pairs of locking bolts the two bolts of each pair being pivotally mounted about respective vertical axes on adjacent fingers and spring-loaded into an end position in which each extends part-way across the gap between
90 said adjacent fingers the arrangement being such that a pipe can be entered into the gap by forcing the two bolts apart against the action of the springs but that the pair then return to said end position and co-operate to prevent such pipe from falling out of the gap.

The invention further provides a pipe handling appliance for use in the system of claim 1, comprising means for gripping and holding a pipe in a vertical attitude, a release head movable into and out of the gap between adjacent fingers and shaped to force the fingers apart during such movement to provide access for the head to a pipe in the gap, said head having at its forward end a recess for accommodating a pipe in the recess for removal of the pipe with the release head.

In preferred arrangements of the system, the two bolts of each pair when in said end position jointly extend over only part of the gap between the fingers, the inner ends of the bolts being spaced apart and the rearward portions of the release head are of rearwardly tapering wedge form capable of entry into the space between the inner ends of the bolts to force and maintain the bolts apart during removal of the release head from a gap between two fingers.

The invention will now be described in more detail with reference by way of example to the accompanying diagrammatic drawings in which:-

125 *Figure 1* shows schematically in perspective part of a racking system according to the invention with a drill derrick, platform deck and a rack or fingerboard,

Figures 2a and 2b are partial side and plan views of the release head,

130 *Figure 3* shows in plan part of a fingerboard of

Figure 1,

Figure 4 shows a section on line IV-IV in Figure 3; the fingerboard lock arrangement is only shown in its entirety in the left hand half of the figure, the right hand half being identical to the left, and

Figure 5 shows a plan of the lock arrangement of Figure 4 on a larger scale.

For a complete understanding of the structural design and operation of the pipe handling appliance, the above mentioned Norwegian Patent Application No. 84 2425 should be referred to.

In this context only a general explanation will be given of the general task of the pipe handling appliance 1, which is to transport drill string sections of approx 30 metres in length between an active position 2' above the drill centre 3 and a non-active storage position 2, with the pipe sections at the bottom being supported in channeled bottom sheets 4, and at the top being supported by engagement in a rack or fingerboard 5, where they are secured by means of locking mechanisms which can be opened and shut. The lower portion of the drill derrick 6 is indicated by dot-and-dash lines. As described in Norwegian Patent Application No. 84 2425, the drill pipes are transported and handled in the vertical position by means of parallel displacement and rotation of the appliance's column-shaped tower, the gripping and holding apparatus 1' releasably supporting the drill pipes in transport between the two positions 2 and 2'.

The fingerboards 5 are generally manufactured of square sectioned steel. The square sections form prongs or fingers 5' the gaps 5' between which are open at the end where the drill pipes are entered and removed.

To prevent the pipes from falling out of the fingerboard 5, a lock arrangement has been provided as shown in Figures 3, 4 and 5.

This locking, interlocking or blocking mechanism consists of a number of spring operated locking bolts 7 which are supported on respective, welded shafts 8, which project vertically from the square section finger 5' and are rotatably supported in upper and lower bearing members, 9 and 10 respectively, in the fingers 5'. In the design illustrated each locking bolt shaft 8 is enclosed by a helical torsion spring 11 whose ends are respectively fastened to shaft 8 and to the lower bearing member 10. The torsion spring operates, through shaft 8, to hold the associated locking bolt in an oblique (seen in plan) locked position, see Figures 3 and 5, where the free end of the locking bolt is directed inward, in other words away from the entry end of the gap 5'. Each locking bolt 7 is thus individually rotatable, completely independently of the others, but the locking bolts 7 on adjacent fingers 5' act together in pairs to block the exit of a drill pipe 2 which is in place inside.

In the locked position the ends of the locking bolts 7 adjacent the shafts 8 are appropriately shaped to abut against a stop 12 which is permanently fixed to the finger 5'. Each of the locking bolts has a limited length so that it only extends partially across the gap 5' between two adjacent

fingers 5' when in the locked position.

When the pipe sections are to be placed in the storage position between the fingers of the fingerboard 5, the pipe 2 itself, which is held and manoeuvred in a vertical attitude by the pipe handling appliance 1, presses a pair of locking bolts 7 inward by overcoming the torsion spring force, so that the pipe can pass by the pair of locking bolts and if necessary past a further pair or several pairs of locking bolts, until the pipe is standing in the desired position in the fingerboard 5. The horizontally directed pressure of the vertical pipe 2 which is held in the pipe handling appliance thus forces the bolts 7 to deflect and allow the pipe to pass, after which the bolts 7 spring out again to the locked position immediately the pipe has passed them. As is apparent from Figure 3, a pipe section 2 may have to be pressed past several pairs of locking bolts 7 before reaching its storage position.

To open the locking mechanism for the purpose of removing the pipes which are stored in the fingerboard, a lock-releasing head 13 is provided at the top of the pipe handling appliance 1 on a level with the objective of being able to move in gaps between the pairs of fingers of the fingerboard and thereby overcome the locking effect of the bolts until it is possible, with the aid of the gripping and holding organs 1' of the pipe handling appliance 1, to withdraw the pipe out from the fingerboard 5.

The head 13 is shaped with a forward concave portion 13' and a rearward, tapered wedge-shaped portion 13''. "Forward" here refers to the end of the head 13 which first enters between the gap 5', and "rearward" to the portion which follows afterward as the head makes its inward movement into the fingerboard.

The corners or outer edges 13' of the concave portion 13' engage during the inward movement of the head as mentioned, the respective locking bolts 7 of a pair and press them inward overcoming the torsion spring force exerted by the spring 11 against the shaft 8 of the locking bolt. As the head 13 moves outward, the gripping and holding apparatus 1' of the appliance 1 hold the pipe 2 to be removed from the fingerboard in place, the locking bolts are deflected to the non-locking position by the wedge-shaped rearward portion 13'' of the head to allow unhindered removal of the pipe.

The pipe handling appliance is itself utilized to operate the locking mechanism on the fingerboard 5, so that the locking mechanism works automatically. The arrangement thus leads, among other advantages, to substantial economic savings as well as simpler, more reliable control of the fingerboard locking mechanism.

CLAIMS

1. A racking system for pipes, comprising a rack having horizontally-extending fingers with intervening gaps open at one end for the receipt and removal of pipes in a vertical attitude, pairs of locking bolts the two bolts of each pair being pivotally mounted about respective vertical axes on adjacent fingers and spring-loaded into an end position

sition in which each extends part-way across the gap between said adjacent fingers the arrangement being such that a pipe can be entered into the gap by forcing the two bolts apart against the action of the springs but that the pair then return to said end position and co-operate to prevent such pipe from falling out of the gap, and a pipe handling appliance comprising means for gripping and holding a pipe in a vertical attitude, a release head movable into and out of the gap between adjacent fingers and shaped to force the fingers apart during such movement to provide access for the head to a pipe in the gap, said head having at its forward end a recess for accommodating a pipe in the recess for removal of the pipe with the release head.

2. A racking system as claimed in claim 1, wherein the recess in said release head is formed by a forwardly facing concavity in the forward ends of the head, whereby during entry of the release head into a gap between fingers the outer edges of the concavity respectively engage the two bolts of each pair to force them apart.

3. A racking systems as claimed in claim 1, wherein the two bolts of each pair when in said end position jointly extend over only part of the gap between the fingers, the inner ends of the bolts being spaced apart.

4. A racking system as claimed in claim 1, wherein the rearward portions of the release head are of rearwardly tapering wedge form capable of entry into the space between the inner ends of the bolts to force and maintain the bolts apart during removal of the release head from a gap between two fingers.

5. A racking system for storing pipes in an upright attitude comprising a rack having horizontally extending fingers with intervening gaps open at one end for receiving and removal of the pipes, and pairs of locking bolts the two bolts of each pair being pivotally mounted above respective vertical axes on adjacent fingers and spring-loaded into an end position in which each extends part-way across the gap between said adjacent fingers the arrangement being such that a pipe can be entered into the gap by forcing the two bolts apart against the action of the springs but that the pair then return to said end position and cooperate to prevent such pipe from falling out of the gap.

6. A pipe handling appliance for use in the system of claim 1, comprising means for gripping and holding a pipe in a vertical attitude, a release head movable into and out of the gap between adjacent fingers and shaped to force the fingers apart during such movement to provide access for the head to a pipe in the gap, said head having at its forward end a recess for accommodating a pipe in the recess for removal of the pipe with the release head.

7. A racking system for pipes substantially as hereinbefore described with reference to and as illustrated in the accompanying drawings.